

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4301

Roll No.

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B. Tech.

(Semester-I) Theory Examination, 2012-13

ENGINEERING MECHANICS

Time : 3 Hours]

[Total Marks : 100

Note : Attempt questions from each Section as per instructions. Assume missing data if any.

Section-A

Attempt *all* parts of this question. Each part carries 2 marks.

$2 \times 10 = 20$

1. (a) With the help of neat sketch explain the principle of transmissibility.
- (b) What are the different types of parallel forces? Explain in brief.
- (c) State Varignon's theorem with mathematical equation.

- (d) What are statically determinate and statically indeterminate beams?
- (e) State parallel axis theorem and perpendicular axis theorem.
- (f) What do you mean by polar moment of inertia?
- (g) Differentiate between Kinematics and Kinetics.
- (h) State D'Alembert's principle and its use.
- (i) What do you understand by the term 'neutral axis and neutral surface'?
- (j) State the assumptions made in theory of pure torsion.

Section-B

Attempt any *three* parts of this question. Each part carries 10 marks. $10 \times 3 = 30$

2. (a) (i) State and prove Varignon's theorem.
- (ii) Determine the magnitude, direction and position of resultant force for a system of forces acting on 5 m square lamina as shown in Fig. 1.

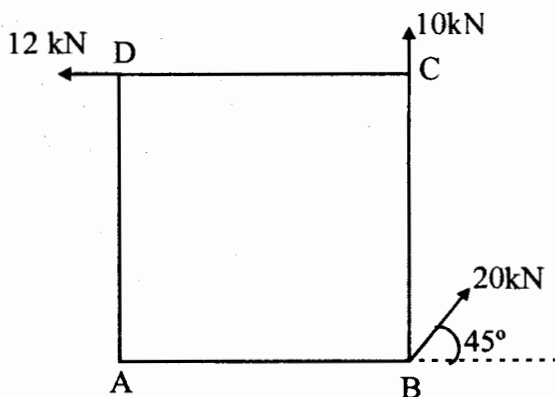


Fig. 1

- (b) A man climbs on a 5 m long ladder. The ladder makes an angle of 60° from the horizontal. The other end of the ladder is supported on a vertical wall. The coefficient of friction between the ladder and wall is 0.2 and between the ladder and floor is 0.3. The weight of ladder and man are 150 N and 800 N. How far can the man climb on the ladder.
- (c) Derive expression of mass moment of inertia for a sphere about its centroidal axis.
- (d) A motorist is driving his car at 90 km/hr. He observes red light 200 m ahead turns red. The traffic light is timed to remain red for

15 sec. If the motorist wishes to pass the light without stopping, find the required minimum deceleration.

- (e) Draw stress-strain diagram for Mild Steel specimen under tension. Discuss all significant points on it.

Section-C

Attempt *all* questions of this Section. Each question carries 10 marks. $10 \times 5 = 50$

3. Attempt any two parts of the following : $5 \times 2 = 10$
- (a) The resultant of two forces when they act at an angle 60° is 14 N. If the same forces are acting at right angles their resultant is $\sqrt{136}$ N (square root). Determine the magnitude of the two forces.
- (b) With neat sketch explain the different types of support reactions and different loading systems for beam.
- (c) Find the power transmitted by belt running over a pulley of 600 mm diameter at 200 rpm. The coefficient of friction between belt and pulley is 0.25, angle of wrap is 160° and maximum tension in the belt is 2.5 kN.

4. Attempt any one part of the following : $10 \times 1 = 10$

- (a) Draw the shear force and Bending moment diagram for the simply supported beam as shown in fig. 2

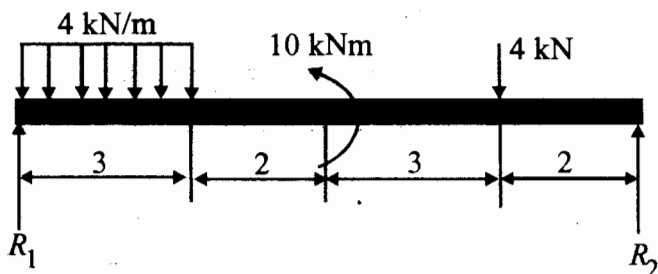


Fig. 2

- (b) Find the forces in member AD, CD and AE of a truss as shown in Fig. 3 by method of section.

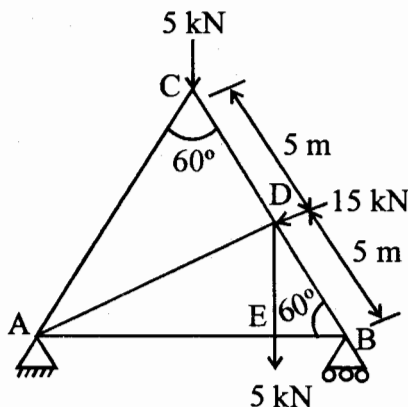


Fig. 3

5. Attempt any one part of the following : $10 \times 1 = 10$
- (a) Derive an expression for mass moment of inertia of right circular solid cone about its axis of rotation having base radius R and height H .
- (b) Find the polar moment of inertia for the I section as shown in Fig. 4.

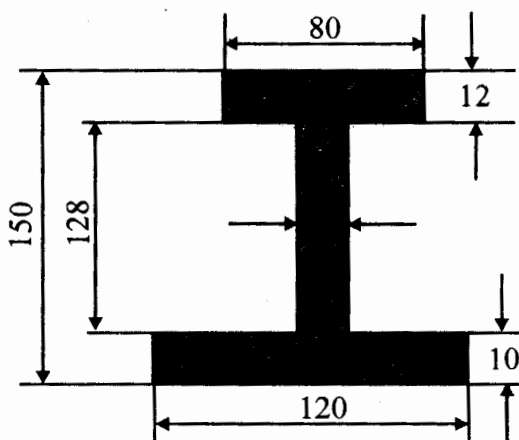


Fig. 4

6. Attempt any one part of the following : $10 \times 1 = 10$
- (a) A wheel rotates for 5 seconds with constant angular acceleration and describes 100 radians during this time. It then rotates with

constant angular velocity and during next 5 seconds describes 80 radians. Find initial angular velocity and angular acceleration.

- (b) Determine the acceleration of the blocks and tension in the string for system given shown in Fig. 5 below, consider the pulley as mass less and $\mu = 0.2$.

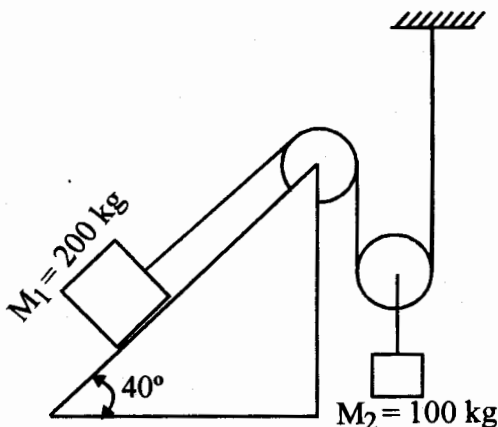


Fig. 5

7. Attempt any one part of the following : $10 \times 1 = 10$

- (a) State the assumptions made in the theory of pure torsion. Derive the torsion formula :

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{l}.$$

- (b) A rectangular beam 300 mm deep is simply supported over a span of 4 meters. Determine the uniformly distributed load per meter which the beam may carry, if the bending stress should not exceed 120 N/mm². Take $I = 8 \times 10^6 \text{ mm}^4$.